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The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. Patent application No. Demande de brevet n°

02076287.8

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

DEN HAAG, DEN
THE HAGUE,
LA HAYE, LE 10/03/03

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Sheet 2 of the certificate
Page 2 de l'attestation

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Optical data storage medium

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Optical data storage medium

The invention relates to an optical data storage medium for recording by means of a focused radiation beam entering the medium through a first radiation beam entry side, said medium having at least a first substrate carrying on at least one side of the first substrate:

- a first recording stack, comprising a first recording layer,
- a second recording stack, comprising a second recording layer, said second recording stack being present at a position more remote from the first radiation beam entry side side than the first recording stack,
- a transparent spacer layer between the first and the second recording stack having a thickness larger than the depth of focus of the focused radiation beam

State of the art and its disadvantages, problems

DVD-ROM has proven to be a very successful optical storage medium. The DVD-ROM standard describes both a single-layer disk (type A; data capacity = 4.7 GB) as well as a dual-layer disk (type C; data capacity = 8.5 GB). A recordable and/or rewritable medium which is compatible with the type A and type C DVD-ROM standard is highly desirable. Furthermore, a double-sided version of the single-layer disc (type B; data capacity = 9.4 GB) and a double-sided version of the dual-layer disc (type D; data capacity = 17.0 GB) are described. Recordable and/or rewritable media which are compatible with the DVD-ROM standard are highly desirable.

For the single-layer DVD (type A) a compatible recordable format (DVD+R) and a nearly compatible rewritable format (DVD+RW) have been defined. For the dual-layer DVD (type C), a compatible dual-layer recordable DVD(+R) medium based on dye materials was described in non-prepublished European Patent Application no. 02075226.7 filed by the present applicant. A dual-layer rewritable DVD(+RW) medium is also feasible, but it seems that such a medium cannot be made compatible with the DVD-ROM standard, because of the limited reflection and transmission of the phase-change materials that are used.

The increase in data capacity of a dual-layer DVD+R compared to a single-layer DVD+R is a clear advantage. The disadvantage is that no data can be rewritten.

It is an object of the invention to provide an optical data storage medium of the type mentioned in the opening paragraph which is compatible with the existing type C or D DVD-read only standard and has a rewritable portion.

This object is achieved by an optical storage medium as described in the opening paragraph which is characterized in that the first recording layer is a write once layer and the second recording layer is a rewritable layer.

Proposed solution

In this invention disclosure a compatible dual-layer DVD+R+RW medium is proposed. The medium consists of two storage layers, of which one of the layers is recordable (+R) and the other layer is rewritable (+RW). The proposed medium is compatible with the type C DVD-ROM standard. The advantage of such a medium is that half of the disk capacity can be rewritten.

A very promising application is the use of the proposed recordable + rewritable dual-layer DVD medium for storage of e.g. high-quality home videos. The raw video material (e.g. from a portable camcorder) can be stored on the recordable layer (and if required by data capacity also partly on the rewritable layer), while the editing and/or scene selection information can be stored and rewritten, i.e. can be easily modified, on the rewritable layer.

An important parameter of the type C DVD-ROM standard is the reflectivity of the storage layers, which must be between 18% and 30% for each of the two layers. Consequently, the upper L0 layer of a compatible DVD+R+RW medium should have a high transmission, sufficient reflection and low absorption. These criteria can be met for a recordable layer based on dye materials, but cannot be met for a rewritable layer using phase-change materials. Therefore, the L0 layer should be a recordable (dye based) layer, while the lower L1 layer should be a highly reflective rewritable layer (based on phase-change materials). Furthermore the maximum data capacity of the proposed single-sided dual-layer recordable and/or rewritable DVD media is limited to 8.5 GB. In order to store two versions of a movie (including extra features) on one disc, e.g. two formats such as full-screen and

wide-screen as is commonly done for movies distributed in the U.S., 8.5 GB of storage capacity is generally insufficient.

Therefore a compatible double-sided dual-layer DVD+R+RW medium is proposed. The proposed medium is compatible with the type D DVD-ROM standard and consequently has a total storage capacity of 17.0 GB.

The double-sided dual-layer DVD+R+RW medium consists of two recordable storage layers and two rewritable storage layers. The two rewritable layers should be located in between the recordable layers, for reason of differences in optical properties between phase-change and dye materials as described above. One of the recordable layers and one of the rewritable layers can be accessed from one side of the disc, while the other two layers can be accessed from the other side of the disc.

Embodiment 1

An embodiment of this invention disclosure is shown in Fig. 1.

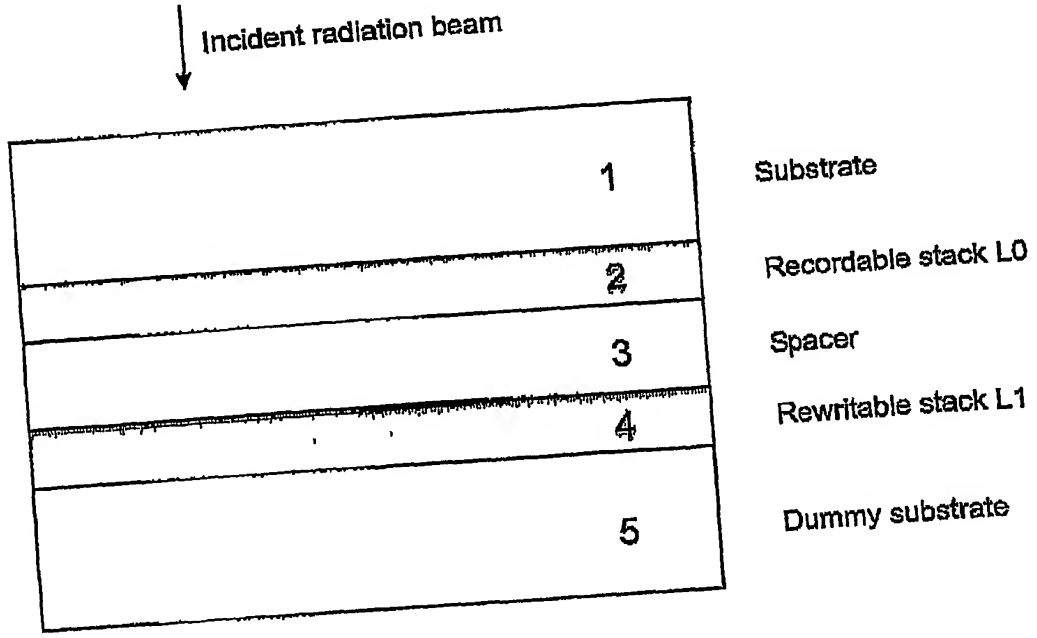

FIG. 1

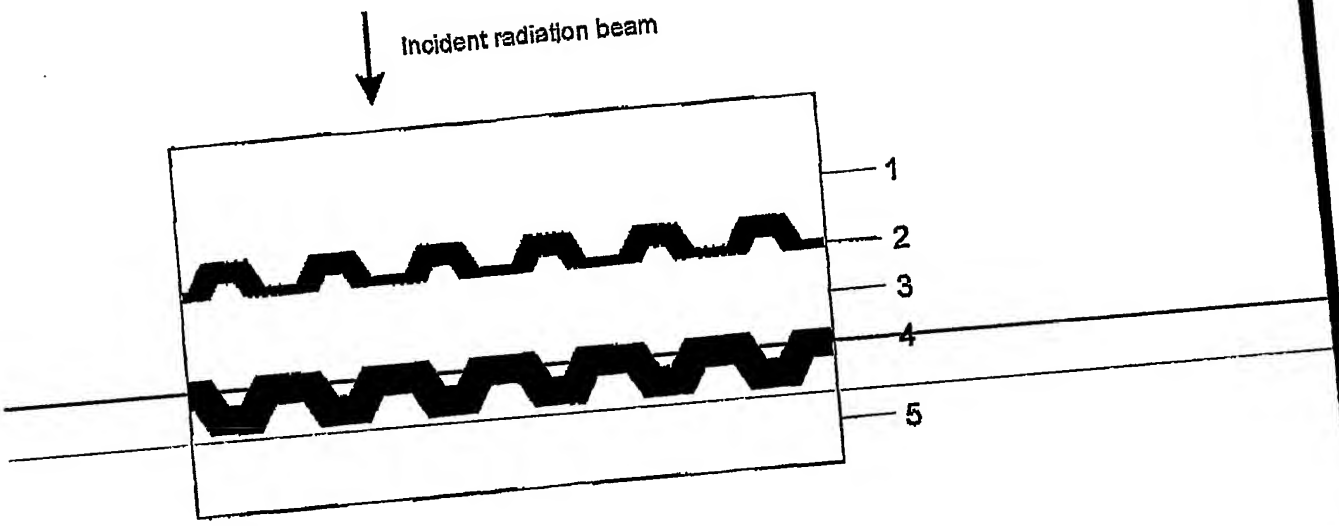

FIG. 2 = FIG. 1 + possible groove structure

1. Substrate (with servo pregroove pattern)

Material: polycarbonate (n = 1.58)

Thickness: 580 m

2. Recordable stack L0

Top to bottom:

a) Material: dye (e.g. cyanine dye or azo dye) (n = 2.2; k = 0.01)
Thickness: 90 nm
Deposited by spincoating

b) Material: Au (n = 0.28; k = 3.9)
Thickness: 8 nm
Deposited by sputtering

3. Spacer

Material: pressure-sensitive adhesive (PSA) (n = 1.5)

Thickness: 40 - 50 m

4. Rewritable stack L1

Top to bottom:

a) Material: ZnS/SiO_2 (80 : 20) (n = 2.15)
Thickness: 135 nm
Deposited by sputtering

b) Material: GeInSbTe alloy (crystalline: n = 2.9; k = 4.8)
hickness: 12 nm
eposited by sputtering

c) Material: ZnS/SiO_2 (80 : 20) (n = 2.15)
Thickness: 23 nm
Deposited by sputtering

d) Material: Al (n = 1.97; k = 7.83)
Thickness: 100 nm
Deposited by sputtering

5. Substrate (with servo pregroove pattern)

Material: polycarbonate (n = 1.58)
Thickness: 580 m

The listed optical parameters n and k are for = 655 nm

Calculated reflectivity and transmittivity:

Recordable stack L0: Reflectivity (R0) = 20.2%

Transmittivity (T0) = 64.1%

Rewritable stack L1: Reflectivity (R1) = 49.1%

Reflection from recordable layer L0 = R0 = 20.2%

Reflection from rewritable layer L1 = $T0^2$ x R1 = 20.2%

The reflection of both layers is in full compliance with the DVD-ROM standard (18% < R < 30%)

Embodiment 2

Another embodiment of this invention disclosure is shown in Fig. 3.

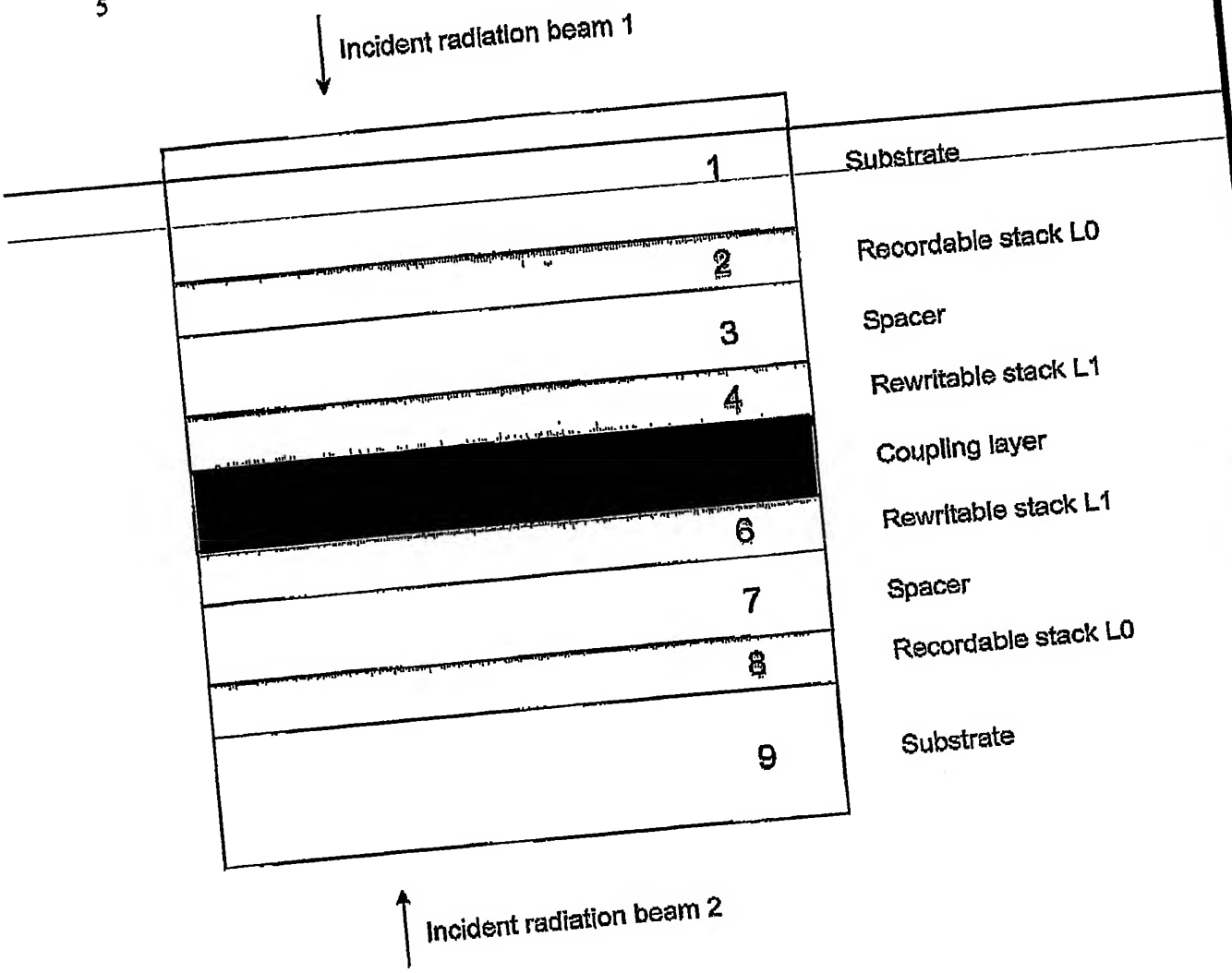

FIG. 3

1. Substrate (with servo pregroove pattern)

Material: polycarbonate (n = 1.58)

Thickness: 580 m

2. Recordable stack L0

Top to bottom (with respect to incident radiation beam 1):

a) Material: dye (e.g. cyanine dye or azo dye) ($n = 2.2$; $k = 0.01$)
Thickness: 90 nm
Deposited by spincoating

b) Material: Au ($n = 0.28$; $k = 3.9$)
Thickness: 8 nm
Deposited by sputtering

3, Spacer

Material: pressure-sensitive adhesive (PSA) with a sheet of plastic with servo pregroove ($n =$ 1.5)
Thickness: 40 - 50 m

4. Rewritable stack L1

Top to bottom (with respect to incident radiation beam 1):

a) Material: ZnS/SiO_2 (80 : 20) ($n = 2.15$)
Thickness: 135 nm
Deposited by sputtering

b) Material: GeInSbTe alloy (crystalline: $n = 2.9$; $k = 4.8$)
Thickness: 12 nm
Deposited by sputtering

c) Material: ZnS/SiO_2 (80 : 20) ($n = 2.15$)
Thickness: 23 nm
Deposited by sputtering

d) Material: Al ($n = 1.97$; $k = 7.83$)
Thickness: 100 nm
Deposited by sputtering

5. Coupling layer

Material: pressure-sensitive adhesive (PSA)
Thickness: 20 - 300 m.

Depending on the thickness of the coupling layer, the thickness of the substrates (1 and 9) may be adjusted in order to have the total thickness of the medium not exceed the maximum thickness as specified in the diso standard, i.e. 1500 m. The thickness range of the substrate however is also limited in order to prevent occurrence of excessive optical aberrations in the focussed radiation beam used for reading and writing in the recording layers.

The pregroove (or guide groove) of the L1 stacks may also be present in the coupling layer in which case the coupling layer may constitute a sheet of plastic with pregrooves on both sides. In this case, spacer 3 and 7 may constitute a pressure-sensitive adhesive (PSA) without pregroove.

6. Rewritable stack L1

Top to bottom (with respect to incident radiation beam 2):

a) Material: ZnS/SiO_2 (80 : 20) (n = 2.15)
Thickness: 135 nm
eposited by sputtering

b) Material: GeInSbTe alloy (crystalline: n = 2.9; k = 4.8)
Thickness: 12 nm
Deposited by sputtering

c) Material: ZnS/SiO_2 (80 : 20) (n = 2.15)
Thickness: 23 nm
Deposited by sputtering

d) Material: Al (n = 1.97; k = 7.83)
Thickness: 100 nm
Deposited by sputtering

7. Spacer

Material: pressure-sensitive adhesive (PSA) with a sheet of plastic with servo pregroove (n = 1.5)
Thickness: 40 - 50 m

8. Recordable stack L0

Top to bottom (with respect to incident radiation beam 2):

f) Material: dye (e.g. cyanine dye or azo dye) (n = 2.2; k = 0.01)
Thickness: 90 nm

b) Deposited by spincoating
Material: Au (n = 0.28; k = 3.9)
Thickness: 8 nm
Deposited by sputtering

9. Substrate (with servo pregroove pattern)
Material: polycarbonate (n = 1.58)
Thickness: 580 m

The listed optical parameters n and k are for = 655 nm

Calculated reflectivity and transmittivity (both sides equal):
Recordable stack L0: Reflectivity (R0) = 20.2%
Transmittivity (T0) = 64.1%
Rewritable stack L1: Reflectivity (R1) = 49.1%

Reflection from recordable layer L0 = R0 = 20.2%

Reflection from rewritable layer L1 = $T0^2$ x R1 = 20.2%

The reflection of both layers is in full compliance with the DVD-ROM standard (18% < R < 30%)

CLAIM:

1. An optical data storage medium for recording by means of a focused radiation beam entering the medium through a first radiation beam entry side, said medium having at least a first substrate carrying on at least one side of the first substrate:

- a first recording stack, comprising a first recording layer,
- a second recording stack, comprising a second recording layer, said second recording stack being present at a position more remote from the first radiation beam entry side side than the first recording stack,
- a transparent spacer layer between the first and the second recording stack having a thickness larger than the depth of focus of the focused radiation beam

characterized in that the first recording layer is a write once layer and the second recording layer is a rewritable layer.

ABSTRACT:

An optical data storage medium for recording by means of a focused radiation beam is described. The beam enters the medium through a first radiation beam entry side. Said medium has at least a first substrate carrying on at least one side of the first substrate:

- a first recording stack, comprising a recordable type recording layer,
- a second recording stack, comprising a rewritable type recording layer. The second recording stack is present at a position more remote from the first radiation beam entry side than the first recording stack. A transparent spacer layer is present between the first and the second recording stack having a thickness larger than the depth of focus of the focused radiation beam. By combining a recordable and a rewritable recording stack the optical data storage medium is compatible with the part of the present type C DVD read-only standard relating to the dual layer reflection requirements.

Fig 1